Encapsulation and Release from Nanoscale Water-in-Oil-in-Water Double Emulsions Stabilized by Block Copolypeptide Surfactants

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Typical microscale double emulsions are restricted from use in a variety of sustained release applications for a number of reasons. First, they are difficult to manufacture: they often require multiple carefully chosen surfactants and several forumulation steps. Second, they are not always stable for long periods of time, and finally, they are too large for most intravenous drug delivery applications. The goal of this project is to expand upon previous research which showed that block copolypeptide surfactants are able to stabilize nanoscale double emulsions in a one step process. This method of preparation largely negates the restrictions typically hindering the application of double emulsions. Emulsions prepared with poly(L-lysine hydrochloride)-block-poly(*racemic*-leucine) ($K_{55}rL_{20}$) were studied to determine the release rates of mock cargos and stability with various hydrophobic phases. The aqueous phase containing surfactant and rhodamine-b was emulsified using tip sonication along with polydimethyl siloxane (PDMS) or vegetable oil. The emulsions were loaded into dialysis bags and dialyzed against ultra pure water. Samples taken from the dialysate were analyzed using a fluorimeter. Cetyl trimethylammonium bromide (CTAB) and polyethylene oxide – block polypropylene oxide (PEO-PPO) were used as control surfactants to generate single emulsions. Preliminary results suggest that $K_{55}rL_{20}$ is able to successfully encapsulate more than 95% of the loaded dye. Upcoming studies will determine the release profiles of the $K_{55}rL_{20}$ emulsions under various solution conditions. The facile production of nanoscale water-in-oil-in-water emulsions with high encapsulation efficiencies could lead to new methods for controlled release applications in agriculture, cosmetics, food preservation, and intravenous drug delivery.